Formerly: Dynascan Corp.

Simpson

INSTRUMENTS THAT STAY ACCURATE

INSTRUCTION MANUAL

DIGITAL VOLTMETER
MODEL 111

SIMPSON ELECTRIC COMPANY
5200 W. Kinzie St., Chicago, Illinois 60644
Area Code 312, Telephone 379-1121
In Canada, Bach-Simpson, Ltd., London, Ontario

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FIGURE 1. THE SIMPSON DIGITAL VOLTMETER MODEL 111

SPECIFICATIONS—MODEL 111 DVM

Solid State High Reliability:
All solid state — 1 Nuvistor. No stepping switches. No relays.

Readout: High brightness 7-bar numerical display with wide-angle visibility. Can be read from as far as 20 ft. under high ambient lighting.

Readout Lamps: 28-volt telephone type, with 100,000 hour rated life.

Accuracy: ±0.1% of reading, ±1 count.

High Input Impedance: 11 megohms, except 1.1 megohm on 1 volt range. Minimizes circuit loading.

Probe: Contains 100 kΩ isolating resistor.

Reference Supply: Highly stable temperature-compensated Zener diode.

Number of Digits: 3.

Display Time: Adjustable from 200 milliseconds to 10 seconds and hold.

Readout Time: Proportional to voltage, 1 second maximum.

4 Ranges: 0-1, 0-10, 0-100, 0-1000 volts.

Ranging: Manual.

Decimal Point: Tracks with range switch. May be remotely programmed.

No Erroneous Over-Voltage Reading: No reading if voltage is beyond capability of the particular range.

Polarity Indicator: If polarity switch is in wrong position, "CHANGE SIGN" automatically appears on readout, indicating wrong polarity.

Manual Reset: When display time is set to HOLD, readings may be taken by depressing manual reset button.

Stability: Rated accuracy is met after 15 minute warm-up period at ambient temperature of 25°C.

Operating Temperature Range: Internal cooling fan with air filter permits operation over range of 32° to 110°F at 0-90° relative humidity.

Power Requirement: 117/230 volts, 50-60 cycle AC, 30 watts.

Size: 5¼" high, 12¾" wide, 10½" deep. **Weight:** 21 lbs.

GENERAL

PHYSICAL CONSTRUCTION: Ease of maintenance and calibration were the principal factors governing parts placement in the Model 111 DVM. Virtually all components are mounted on circuit boards for ready access to test points and control adjustments.

POWER REQUIREMENTS: This instrument is delivered from the factory ready to operate from 105/125 volt, 50/60 cycle AC mains. However, it can be rewired to operate from 210/250 volt AC mains by changing the power transformer connections in accordance with Figure 2.

ACCURACY & RESOLUTION: The rated accuracy of the Model 111 is 0.1% of the reading in addition to ±1 digit in the least significant figure. Thus, when the instrument is reading the highest voltage possible (999 volts), its maximum error will be 2 volts (instrument error of .1% plus the 1 digit of resolution error). By selecting a range with a voltage readout as close to full scale as possible the significance of the resoluion error can be minimized.

AMBIENT TEMPERATURE: The Model 111 has been calibrated at a temperature of 25°C (77°F), and has a net temperature coefficient of ±.01% per degree C. Operation at elevated temperatures will introduce an error in accordance with this coefficient. The maximum ambient temperature for operation is 50°C (125°F).

REFERENCE VOLTAGE: The accuracy of this DVM is largely dependent on the stability of its internal reference voltage. Because of this, a highly stable, temperature compensated Zener diode (D-701) is used to develop this reference against which all measurements are made.

BALANCING TIME: This is the amount of time required by the instrument to read the applied voltage and display it in digital readout form. The maximum time required for balancing on any range is one second for full scale reading. For any other reading, the balancing time, in seconds, is the fractional value of the full scale reading. Thus, a reading of 39.5 volts on the 100V range requires .395 seconds for balancing.

REMOTE TRIGGERING OF DISPLAY: When the *display time* control is in the HOLD pisition the voltage reading will remain on display for an indefinite period, or until the *manual* button is depressed. This manual facility can be initiated remotely by connecting a switch cable of the desired length to the octal socket on the rear chassis apron.

READOUT: The digital display can be read to distances of 20 feet under high ambient illumination. The display numerals are composed of 7 individually lighted bars and activated by 1-2-4-2 binary coded logic from the internal counters. Long-life, type 1764D telephone lamps provide the illumination and are readily accessible for replacement by removal of the printed circuit boards.

INPUT IMPEDANCE & INPUT: To minimize circuit loading, the Model 111 has been designed with an 11 megohm input impedance on the three higher voltage ranges, and a 1.1 megohm input impedance on the 1 volt range. The input is single ended with chassis ground.

INPUT PROBE: A 100K ohm precision resistor is included in the probe to provide decoupling from the probe cable capacity for measurement of voltages in active circuits. This resistor is part of the instrument calibration. Replacement with any other 100K, ½% resistor could result in a maximum error of 0.05% on the 1V range and a negligible (.005%) error on the other ranges. This resistor is followed by the attenuator circuit and a .01 mfd shunt capacitor. The resistor and capacitor form a 1KC, low pass filter which limits the effect of noise or signals in the circuit being tested by the Model 111.

NOTE: Because this instrument was calibrated with the probe supplied it is imperative that you use only this probe when making measurements where maximum accuracy is desired.

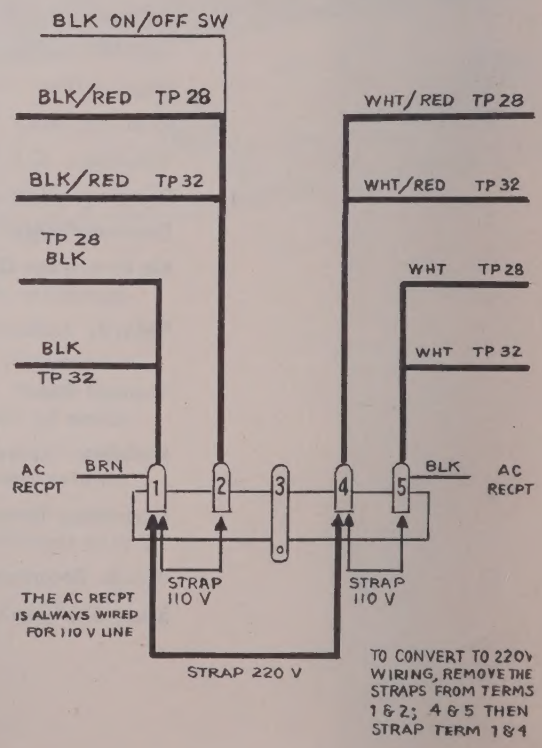


Figure 2. Power Transformer Connections.

CONTROL DEFINITIONS

POLARITY SWITCH: When this switch is in the POSITIVE position, a + sign will appear in the display window indicating that the tip of the input probe should be connected to the positive side of the voltage to be measured. The probe clip should be connected to the negative side.

When the switch is in the NEGATIVE position, a — sign will appear in the display window indicating that the tip of the probe should be connected to the negative side and the probe clip to the positive side.

When attempting a reading, if the polarity of the voltage to be measured is opposite that shown in the display window the word "CHANGE SIGN" will appear and the instrument will read 000 volts. Rotating the *polarity* switch will cause the proper sign to appear and the instrument to function properly.

DISPLAY TIME CONTROL: This control has the AC power ON/OFF switch attached to it. Clockwise rotation of this control applies AC power to the instrument and increases the display time of the voltage readout. When rotated fully clockwise to the HOLD position, the voltage readout will be displayed for an indefinite period. As the control is rotated counterclockwise, the display time becomes progressively shorter. In its maximum counterclockwise position, display time is at a minimum. Further rotation disconnects the AC power from the instrument (AC off).

Note: The minimum display time can be further shortened by reducing the value of C-421 on the control board to 16 MF.

MANUAL BUTTON: When the *display time* control is in the HOLD position, new readings may be initiated at any time by depressing the *manual* button. This function can be programmed remotely since it represents nothing more than a low voltage switch closure.

RANGE SWITCH: This switch manually selects one of four voltage ranges; 1,V 10V, 100V, 1000V. Each number represents the full scale capability of that range. The actual maximum voltage that can be read on each range is .999V, 9.99V, 99.9V, 999V. The decimal point automatically tracks with the rotation of the range switch.

If the voltage to be measured exceeds the range for which the Model 111 has been set, the displays will flicker (continue to count) and never reach a reading. Proper setting the *range* switch will correct this and enable the instrument to read properly.

OVER-VOLTAGE: The maximum over-voltage that the instrument can safely handle is: 50 volts for the 1V range 500 volts for the 10V range; 1000 volts for the 100V and 1000V ranges. Voltages in excess of these can damage the instrument.

OPERATING INSTRUCTIONS

NOTE: The input of the Model 111 is single ended with one side going directly to chassis ground. If the voltage to be measured is not with reference to chassis ground, read "MEASUREMENTS WITH FLOATING GROUND" before using this instrument.

MEASUREMENTS WITH COMMON GROUND:

1. Connect the line cord of the Model 111 to an appropriate AC power receptacle.
2. Apply power to the instrument by rotating the *display time* control clockwise. Allow approximately 5 minutes to reach stabilizing temperature.
3. Rotate *polarity* switch to agree with polarity of voltage to be read.
4. Rotate the *range* switch to the proper voltage range. If the voltage is unknown, select the highest range and work backward until you obtain the desired readout.
5. Connect the probe tip to the point of measurement. Connect the probe clip to a ground point on the chassis under test.
6. Rotate the *display time* control for desired readout time. When this control is in the HOLD position new readouts can be initiated by pressing the *manual* button.

OFFSET ERROR: For greatest accuracy the Model 111 should be checked periodically for offset error. Select the 1V range and rotate *display time* control to a minimum. Connect the probe clip and probe tip together.

Observe the readout display for both the negative and positive positions of the polarity switch. If the readout is 000 for both positions no offset error is present. If the readout is 001, or 002, etc., for either polarity (but not both), an offset error has developed. This is easily rectified by adjusting R-307 in accordance with the OFFSET ADJUSTMENT instructions.

MEASUREMENTS WITH FLOATING GROUND: See Figure 3. When the voltage to be measured is not with reference to ground, the Model 111 or the circuit being measured should be floated, i.e., isolated from ground. The easiest, but least desirable method, is to use a 3-wire to 2-wire line cord adapter on the Model 111. This will successfully isolate the DVM (and probe clip) from power line ground. However, with this method stray electromagnetic radiation will affect readout accuracy to some degree. THE DVM SHOULD NEVER BE ISOLATED FROM GROUND POTENTIAL BY MORE THAN 250 VOLTS.

The preferred method of isolation is to make a normal 3-wire power connection to the DVM and float the circuit under test by means of an isolation line transformer. This method does not impose the 250 volt limitation explained above, and the DVM's sensitivity to ambient radiation is minimized.

CAUTION: WHEN MAKING MEASUREMENTS WITH A FLOATING GROUND A SHOCK HAZARD DOES EXIST AT THE ISOLATED CHASSIS. OBSERVE PROPER SAFETY PRECAUTIONS.

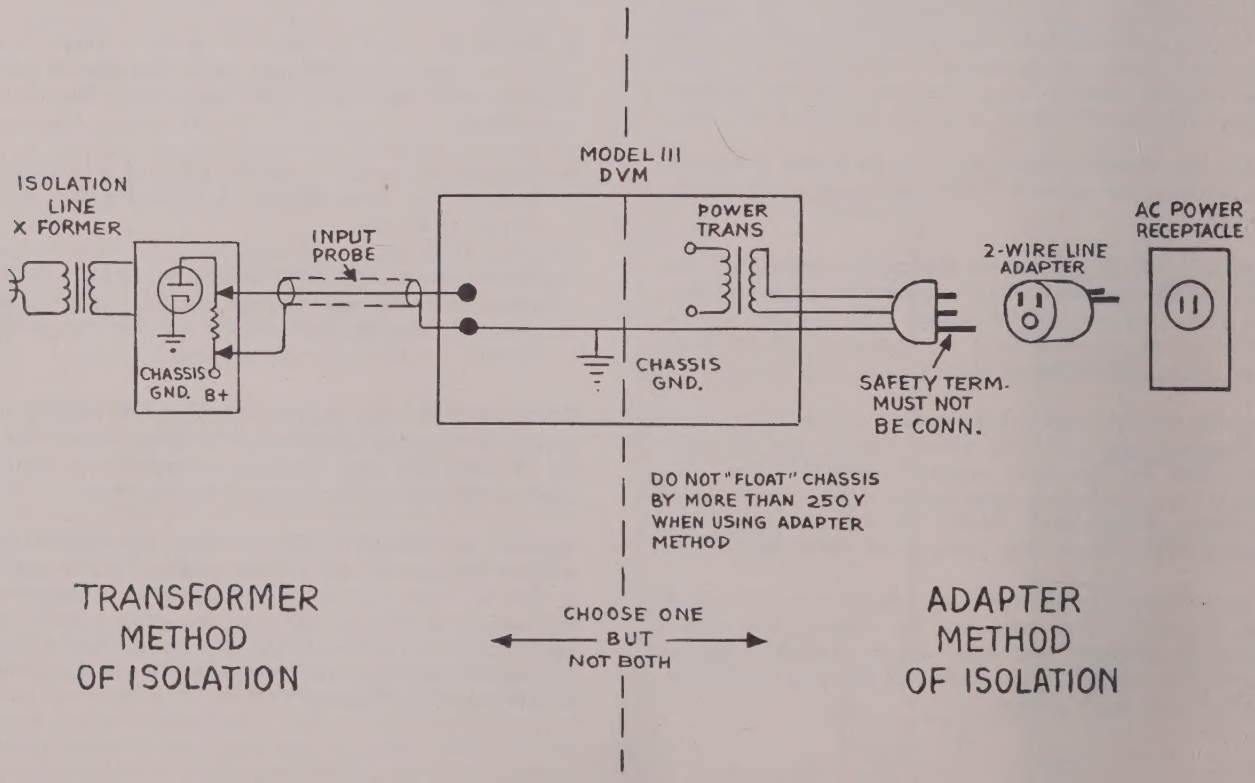


Figure 3. Power Connections for "Floating Gnd" Measurements.

CALIBRATION PROCEDURES

If the procedures outlined here are performed carefully, your instrument will be accurate to within ½ count of the least significant figure for the offset adjustment, and within 1 count on the voltage readouts.

OFFSET ADJUSTMENT: See Figure 4.

1. Apply power to the Model 111 and allow five minutes to warm up.
2. Short the probe tip and probe clip together.
3. Set *Range* switch to *1V* position.
4. Rotate *Polarity* switch to position that causes a readout of 001, 002, etc.
5. With a screwdriver rotate the shaft of R-307 until the readout is 000. This adjustment is made through the access hole in the back of the case.

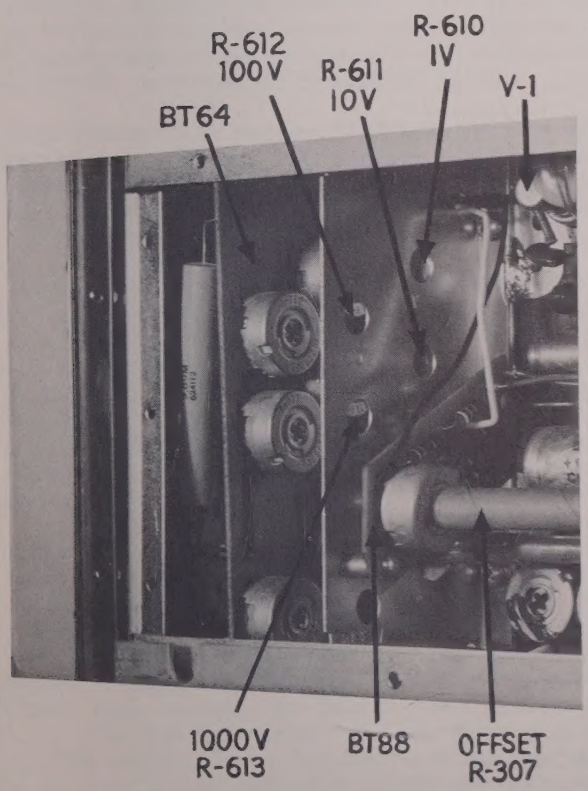


Figure 4. Offset and Voltage Calib.

6. Place *polarity* switch in opposite position and observe reading. If it is not 000, slowly rotate R-307 in a direction opposite your first adjustment while simultaneously alternating the *polarity* switch between negative and positive and observing the readout. When the readout is 000 for both positions of the *polarity* switch, the offset adjustment is complete.

1V CALIBRATION: See Figure 4.

Notes: When any volt range has been adjusted, it is necessary that all succeeding (higher) ranges be recalibrated because of interaction between the ranges. The calibration of all voltage ranges must be performed with a phillips screwdriver having an insulated shaft. The case and shield must be removed.

1. Correct for offset error if present.
2. Connect probe to a 0.950 positive voltage source.
3. Rotate *range* switch to *1V* position.
4. Rotate *polarity* switch to POSITIVE.
5. Adjust *display time* control for a convenient display time.
6. Adjust the 1V calibrate potentiometer (R-610) until a reading of 0.950 is observed on every readout cycle.
7. Recalibrate the 10V, 100V and 1000V ranges.

10V CALIBRATION: See Figure 4.

1. Place *range* switch in 10V position.
2. Follow the 1V CALIBRATION procedure using a positive voltage of 9:50V. Adjust the 10V calibrate potentiometer (R-611).
3. Recalibrate the 100V and 1000V ranges.

100V CALIBRATION: See Figure 4.

1. Place *range* switch in 100V position.
2. Follow the 1V calibration procedure using a positive voltage of 95.0V. Adjust the 100V calibration potentiometer (R-612).
3. Recalibrate the 1000V range.

1000V CALIBRATION: See Figure 4.

1. Place *range* switch in 1000V position.
2. Follow the 1V calibration procedure using a positive voltage of 950V. Adjust the 1000V calibration potentiometer (R-613).

SIMPLIFIED THEORY OF OPERATION

The Model 111 DVM is basically a null seeking-balancing system that samples a measured portion of the probe input voltage and compares it to an opposing voltage that is being developed internally. When both voltages are equal and opposite, the unit is said to be at equilibrium and a steady state readout will exist at the counters.

In order to provide numeric readout, the development of the internal voltage is divided into 1000 discreet steps (each step corresponding to a number between 000 and 999). As this voltage increases by its 1/1000 increments, the counters scale until equilibrium is attained.

The three stages of decade counters provide the 1000 possible output states of 000 to 999. A 7-bar display is connected to each of the decades to provide the readout of the 1-2-4-2 logic in each of the counters. The counters also drive the digital to analog converter which divides a reference voltage into 1000 steps. At the count of 000, the D to A Converter output is 0 volts. At the count of 999 the output has increased to approximately 5 volts. As the counters scale from 000 to 999 (because of added pulses), the output of the D to A Converter (consisting of a staircase waveform), is increased by 1/1000 of the reference voltage (per pulse). Because no more than one second is required to achieve balance, the counter input repetition frequency becomes 1 KC which, in turn, becomes the clock rate of the instrument.

The polarity switch reverses the ouput sense of the D to A Converter. That is, a negative going staircase is generated when a positive voltage is measured. Conversely, a measured negative voltage results in a positive going staircase.

When the counters are in the 000 state, the D to A Converter output voltage (E2) is zero. When E2 and a positive input voltage (E1) are applied to the summing network, (R-1 and R-2), a positive voltage, representing an out of balance signal, appears at the summing point. The clock period of 1 millisecond is divided into two parts.

During the first part (approximately 500 microseconds), grounding switches at the input and output of the amplifier are closed, causing a no signal condition at the counters and allowing the input and output capacitors to charge to their steady state values. During the second part of the clock period the switches open allowing the positive out of balance signal to be amplified as a positive going pulse. The series diode (D-1) passes this pulse to the counters causing a count of 001 to appear. This causes the output of the D to A Converter to go negative by 1/1000 of the reference voltage. This completes the action of the first clock period.

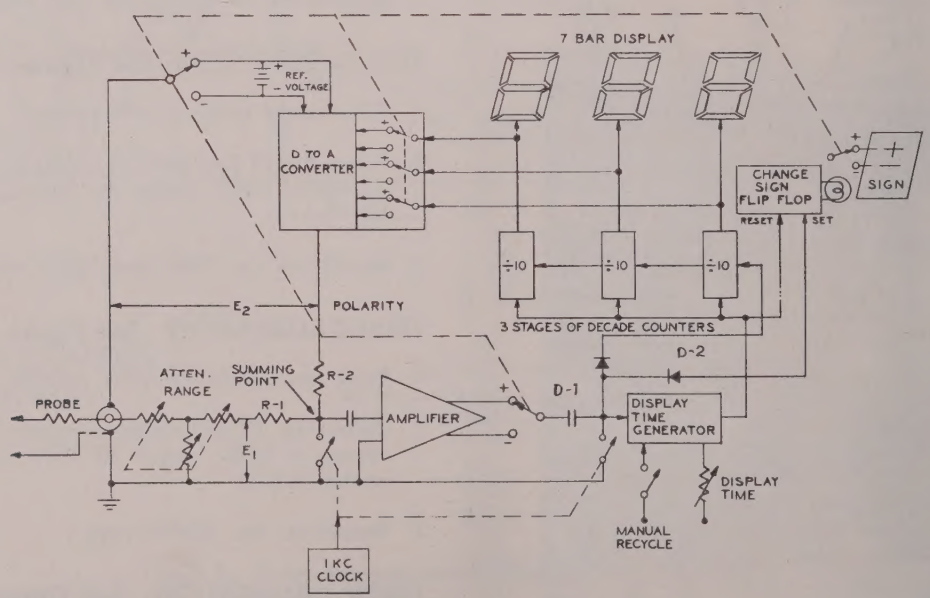
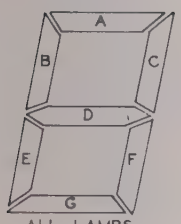


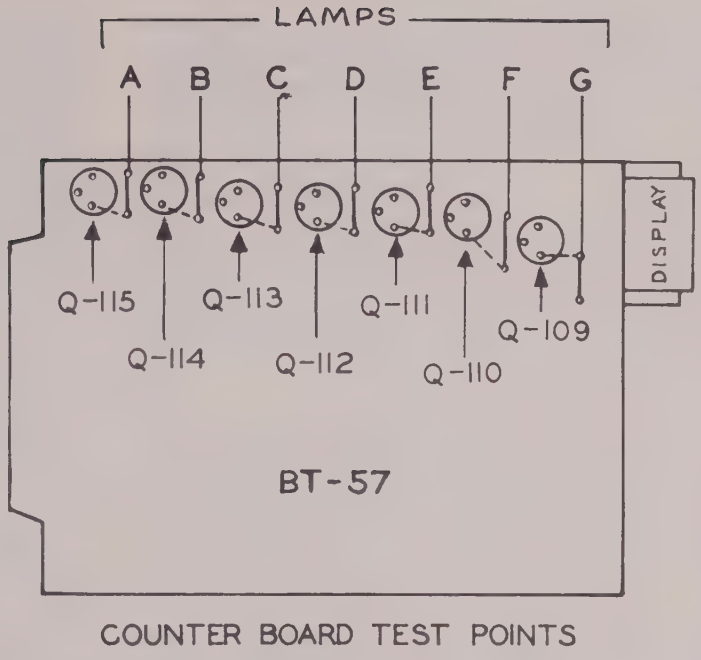
Figure 5. Simplified Block Diagram.



ALL LAMPS
1764 D
(SELECTED)

LAMP \ NO	1	2	3	4	5	6	7	8	9	0
A	OFF	ON	ON	OFF	ON	ON	ON	ON	ON	ON
B	OFF	OFF	OFF	ON	ON	ON	OFF	ON	ON	ON
C	ON	ON	ON	ON	OFF	OFF	ON	ON	ON	ON
D	OFF	ON	ON	ON	ON	ON	OFF	ON	ON	OFF
E	OFF	ON	OFF	OFF	OFF	ON	OFF	ON	OFF	ON
F	ON	OFF	ON	ON	ON	ON	ON	ON	ON	ON
G	OFF	ON	ON	OFF	ON	ON	OFF	ON	ON	ON

LAMP DUTY TABLE



COUNTER BOARD TEST POINTS

Figure 6. Lamp Locations and Duty Cycle.

The process is duplicated again in the second clock period. During the first part of the second period the switches are closed to establish 0 volt reference. In the second part of this period they are opened and a positive out of balance condition at the summing point will initiate another count. The instrument will try again for balance.

If the voltage to be measured is in range, then at some count between 000 and 999, a null or slightly negative voltage will be obtained at the summing point. At this time no more pulses can pass to the counters through D-1 and the instrument reaches equilibrium.

At equilibrium, the display time generator starts its functions to hold the final state displays of the counter for a time dependent upon the setting of the display time control and/or the manual recycle button. It also (not shown in Simplified Block Diagram) locks out pulses from the amplifier so that stray noise spikes or removal of probe will not cause spurious readings. At the end of the display cycle the counters are reset and the instrument repeats the entire cycle just described.

In the case of a wrong polarity input signal, a negative going pulse will appear at the output of the amplifier during the second ½ cycle of the first sampling period (counters=000). D-1 prevents them from counting. However, the other diode D-2 passes the negative pulse and triggers the change sign flip-flop. This lights the "CHANGE SIGN" lamp. Reversing the Polarity switch reverses the sense of the D to A Converter output and the sense of the amplifier output so that a negative out of balance signal at the summing point will initiate a count and each count will produce a positive step at the D to A Converter output.

MAINTENANCE

WARNING: Care must be exercised when making measurements at connectors since accidental shorts may cause component failure.

LAMP CHECKS

7-BAR DISPLAY LAMPS: Switch to the 1V range and connect a 1.5 to 50V DC source to the input probe, observing proper polarity. The Model 111 should now flicker continuously since an over-voltage has been applied. Locate the bulb (or bulbs) which do not light. Connect the negative lead of a 20,000 ohm per volt DC voltmeter to the test point associated with the suspected lamp. See Figure 6. (This test point will be the collector of one of the driver transistors). Connect the positive lead of the voltmeter to V_G on the power supply board. See Figure 7. If the meter reads 0.6 volts, the lamp filament is open and should be replaced. If the meter reads approx. 20 volts, the counter circuit is defective and the board should be returned for service.

However, if spare board stock is maintained, another model DC-3 board, of identical type, can be substituted without changing the calibration of the instrument.

DECIMAL POINT LAMP: Rotate the range switch to the position that lights the decimal point lamp to be checked. Measure the DC voltage between (pos) V_G on the power supply board (Figure 7) and terminal V of the appropriate counter or control board. See connector wiring diagram Figure 9. If the voltage is zero, the lamp is open. If the voltage is approx. 20 volts, the harness or range switch is open.

PLUS-MINUS LAMPS: Rotate the POLARITY switch to the position that will light the lamp to be checked. Measure the DC voltage between (pos) V_G on the power supply board (Figure 7) and terminal A (—) or B (+) at the control board, (Connector V) see Figure 9. If the voltage is zero, the lamp is open. If the voltage is 20 volts, the wiring harness or polarity switch is open.

"CHANGE SIGN" LAMP: The circuitry for this lamp is not readily reached by test probes. If it fails to light when a voltage of incorrect polarity is applied to the probe, the lamp should be replaced by one that is known to be good. If the replacement lamp fails to light, the control board requires service.

LAMP REPLACEMENT: Burned out bulbs should be replaced by type 1764D selected telephone lamps only. Failure to use this type bulb may cause premature burn out or circuit damage.

POWER SUPPLY VOLTAGE CHECKS:

UNREGULATED SUPPLY: This circuit supplies power to the counters and control circuitry.

NOTE: All voltages measured with respect to V_G (pos) on the power supply board. See Figure 7.

Measure the voltage at V_B on the control board. See Figure 8. For this measurement, carefully apply the test prod to the case of R-447. If R-447 is accidentally shorted to the resistor next to it, Q-201 in the power supply WILL BE DAMAGED. Your reading should be +11 volts with a tolerance of ±0.8 volts. The ripple content should be no greater than 100 millivolts peak to peak.

Measure the voltage at V_C (R-459) on the control board. See Figure 8. It should be —1.75 to —1.85 times the value of V_B. That is, if V_B is 11.0 then V_C will be —19.2 to —20.4 volts. The V_C ripple content should be no greater than 100 millivolts peak to peak.

Measure the voltage at V_I, at the cathode of D-210. See upper corner of Figure 9. Your voltage reading should be between —17 and —19 volts.

Voltages out of range indicate a defective power supply. Refer to schematic, Figure 11. High voltage together with high ripple generally indicate defective filter capacitors, particularly C-203 and C-205. Correct voltages with high ripple generally indicate defective capacitors in the bases of the dynamic filters, namely C-201, C-202 and C-204.

REGULATED SUPPLY: This circuit supplies power to the reference and low level signal circuits located on the amplifier board.

NOTE: All voltages measured with respect to terminal C of connector I See Figure 14.

Measure voltage at terminal A of connector I. This should be +5.7 to +6.7 volts. An out of range voltage generally indicates a defective nuvistor (V-1). This tube must be good before making further measurements. See Figure 4 for location of V-1.

Measure voltage at terminal B of connector I. This should preferably be between +55 and +95 volts. This voltage supplies the plate for V-1 and its actual value is not critical as long as it is greater than +55 volts.

Measure voltage at terminal L of connector I. This is the regulated supply and should be —20 volts ±0.3 volts at a 117V line. If it is not, the unit is defective and should be returned for service. Since this supply is directly related to the calibration and accuracy of the instrument, only laboratories equipped for precision calibration should attempt the repair.

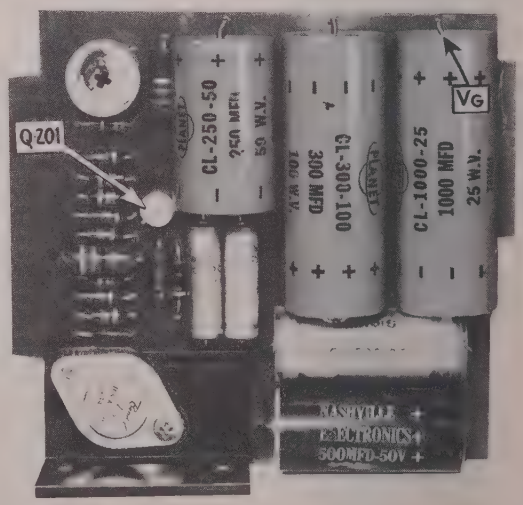


Figure 7. Power Supply Board, BT-62.

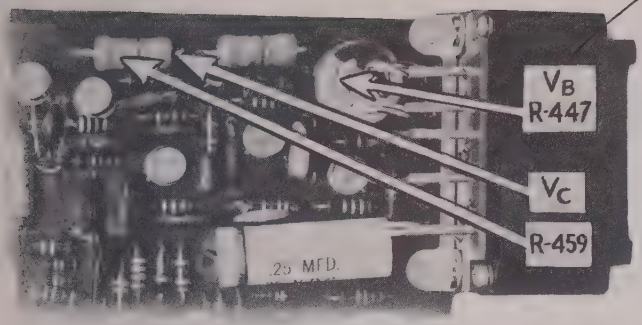


Figure 8. Control Board, BT-76.

Counter Board

D-101 to D-110 IN-48 .....
D-111 .....
Q-101 to Q-115 2N1404 .....
PL-A to PL-H GE-1764D, Selected .....
Bracket, display readout .....
Spacer, readout mtg. .....

Power Supply

R-202 2.26K ½W 1% Carbon Resistor .....
R-204 150 Ohm 20% Wire Wound Pot.....
C-201 80 MFD 16WV Electrolytic Capacitor
C-202 80 MFD 16WV Electrolytic Capacitor
C-203 500 MFD 25WV Electrolytic Capacitor
C-204 1000 MFD 25WV Electrolytic Capacitor
C-205 500 MFD 50WV Electrolytic Capacitor
C-206 250 MFD 40WV Electrolytic Capacitor
C-207 300 MFD 100WV Electrolytic Capacitor
D-201 D-S150 Diode .....
D-202 D-S150 Diode .....
D-203 D-HC67 Diode .....
D-204 D-HC67 Diode .....
D-205 D-S150 Diode .....
D-206 D-S150 Diode .....
D-207 D-S150 Diode .....
D-208 D-S150 Diode .....
D-209 D-360 Diode .....
Q-201 2N696 NPN Transistor .....
Q-202 Bendix B-1563 Transistor .....
Transistor Mounting Bolt .....
Transistor Mounting Washer .....
Transistor Mounting Nut .....
Transistor Heat Sink .....
Transistor Mica Insulator .....
Transistor Heat Sink Mounting Bolts

Offset Adjustment

R-307 300 Ohm 20% W.W. Pot. .....
D-301 & D-302 .....
Spacer Circuit Board .....
Rod, extension .....
Collar, extension rod .....
Tip, extension rod .....

Control Board

R-447 3K 20% W.W. Pot. .....
R-453 330 Ohm ½W 5% Glass Resistor ....
R-454 & R-459 220 Ohm 2W 5% Glass Resistor
C-421 50 MF 25V Lytic Cap. .....
C-424 4MF 64V Lytic Cap. .....
C-430 80 MF 16V Lytic Cap. .....
D-401 to D-410 IN-48 .....
D-411 .....
D-412 to D-415 IN-48 .....
I-1 to I-4 GE-1764D Selected Lamps .....
Q-401, Q-402, Q-410, Q-418, Q-419 2N1808
All other transistors are 2N1404....

D to A Converter

R-501 10K ½W .05% W.W. ± 10 PPM .....
R-502 & R-503 20K .1% W.W. ± 20 PPM ..
R-504 40K ½W .2%W.W. ± 20 PPM .....
R-505 100K ½W .5% Film .....
R-506 & R-507 200K ½W 1% Film .....
R-508 1% 400K ½W Film .....
Q-508, Q-512, Q-506 .....
Q-509, Q-511, Q-505, Q-503 .....
Q-510, Q-507, Q-504, Q-502 .....
Q-501 .....
Q-521 .....
Q-522, Q-524, Q-527,Q-530 .....
Q-523, Q-525, Q-529, Q-531 .....
Q-526, Q-528, Q-532 .....
S-76 Polarity Switch .....
Bracket, readout display .....
Spacer, readout mtg. .....

Attenuator Board

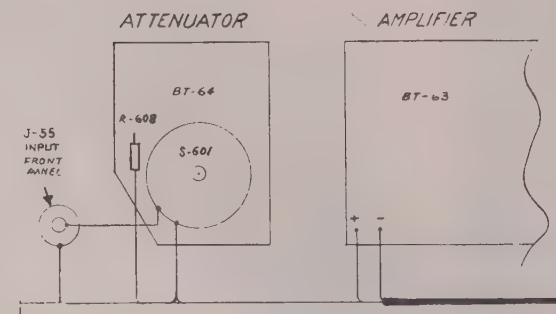
R-601 1M ½W 1% Metal Film Resistor .....
R-602 1.11M ½W 1% Metal Film Resistor ...
R-603 1.11M ½W 1% Metal Film Resistor ...
R-604 9.79M 2W 1% Metal Film Resistor ...
R-605 8.79M 2W 1% Metal Film Resistor ...
R-606 9.89M 2W 1% Metal Film Resistor ...
R-609 to R-613 5.5K 10% Wire Wound Pot .
N-601 NE-2 Neon Lamp .....
C-601 .01 MFD 1600WV 20% Disc Ceramic .
S-601 .....
Switch Coupling .....

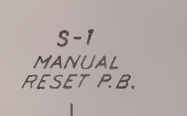
Amplifier Board

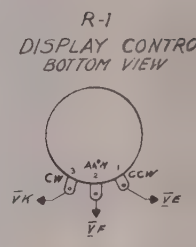
R-712 3K 20 % W.W. Pot. .....
R-722 750 Ohm 2W 2% Glass Resistor ....
R-727 3K 20% W.W. Pot. .....
R-731 300 Ohm 20% W.W. Pot. .....
R-732 330 Ohm 2W 2% Glass Resistor ....
R-733 1.5 Ohm ½W 5% W.W. Resistor....
R-735 & R-736 1K 20% W.W. Pot.....
R-737 & R-738 300 Ohm 20% W.W. Pot....
C-701 68 PFD 500V 5% Silver Mica Cap. ...
C-702 1MF 125V 10% Poly. .....
C-703 50 MF 25V Lytic .....
C-704, C-705, C-706 40 MF 16V Lytic .....
C-707 10 MF 25V Lytic .....
C-710 300 MF 100V Lytic Cap. .....
C-711 32 MF 40V Lytic .....
C-713 50 MF 25V Lytic .....
C-715 2.5 MF 16V Lytic .....
C-716 1000 MF 10V Lytic .....
C-721 .33 MF 125V Poly. .....
Q-701 to Q-705 2N1404 .....
Q-706 Bendix B1563 .....
Q-707 2N1404 .....
Q-708 2N1808 .....
D-701 Zener .....
D-702 IN48 .....
V-1 7586 Nuvistor .....
Socket, Nuvistor .....
Decimal PT Switch .....

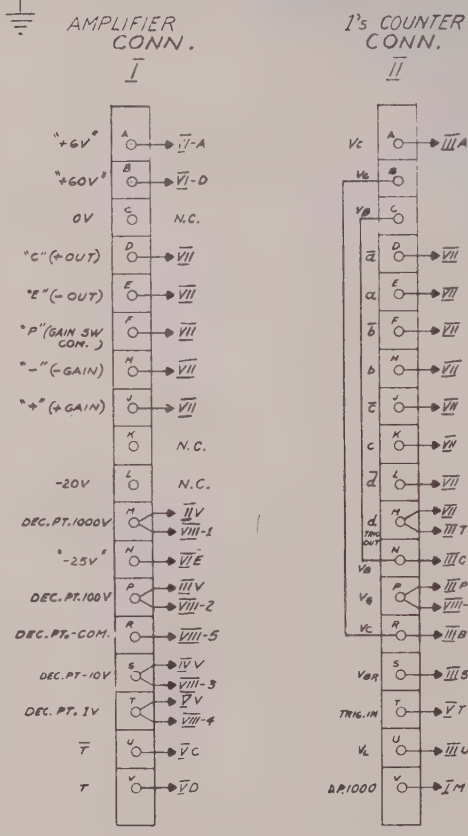
Chopper

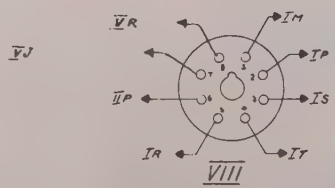
D-801 .....
D-802 Photo Diode .....
TA-8 Trans, chopper .....
PL-12 Selected neon lamp NE-2H .....
Bracket, photo diode .....
Clamp, photo diode .....
Mount, photo diode .....
Eyelet, photo diode .....
Spacer, Circuit Board .....
Retainers, Circuit Board .....
Bracket, neon clip mtg. .....
Channel, chopper .....
Clip, neon .....
Glass rod .....





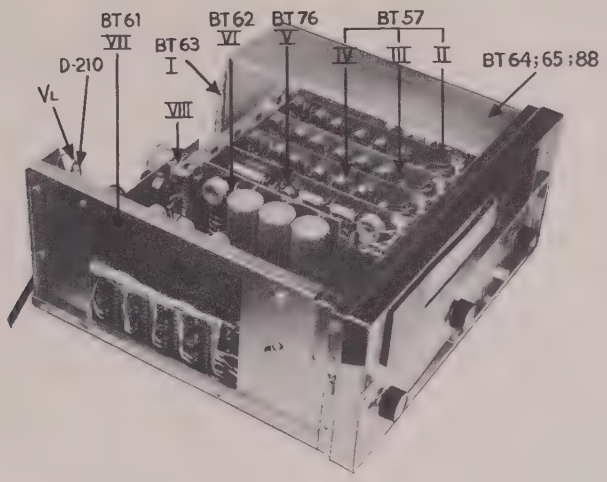


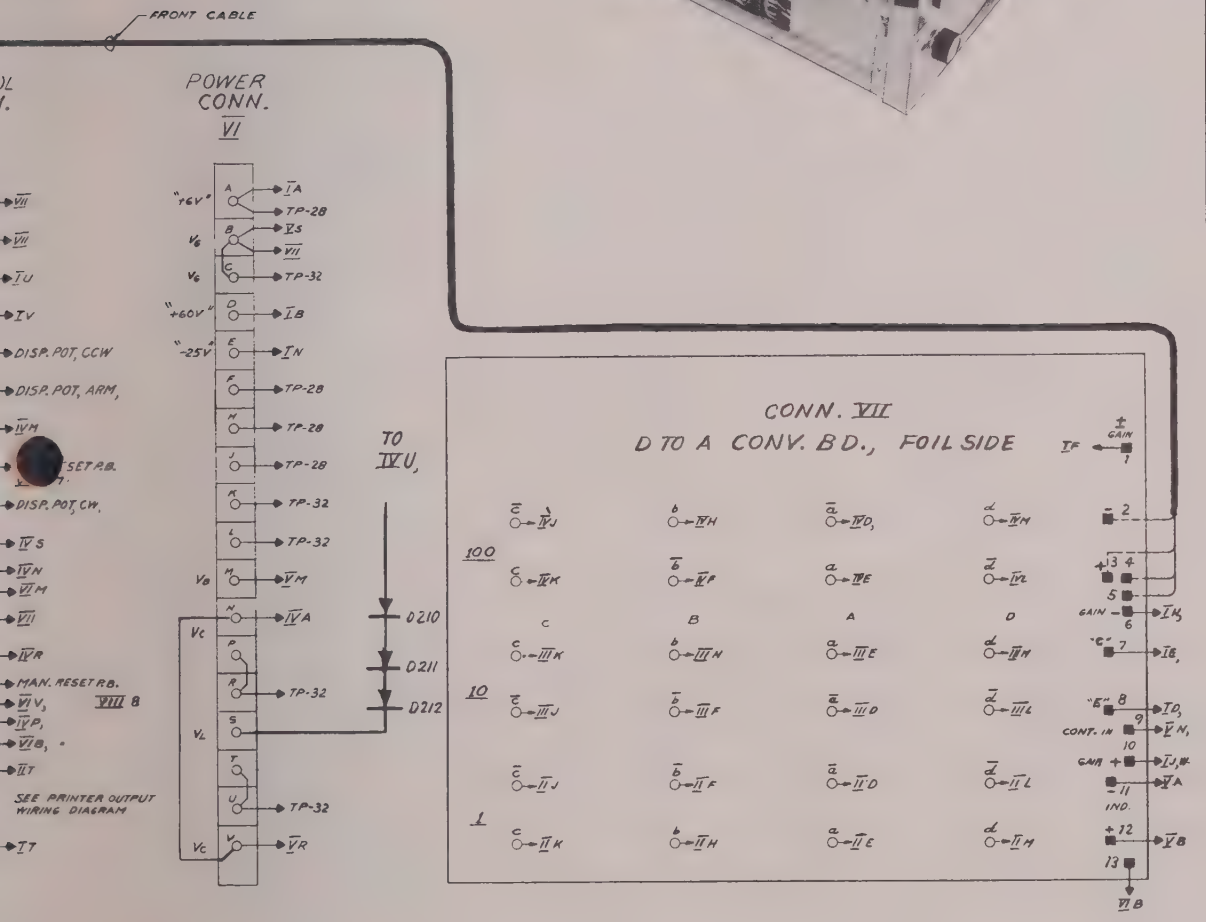




REMOTE DEC. PT. CONNECTOR
& DISPLAY SW.
(REAR CHASSIS)
CONN.

Figure 9. Wirin





gram of Connectors.

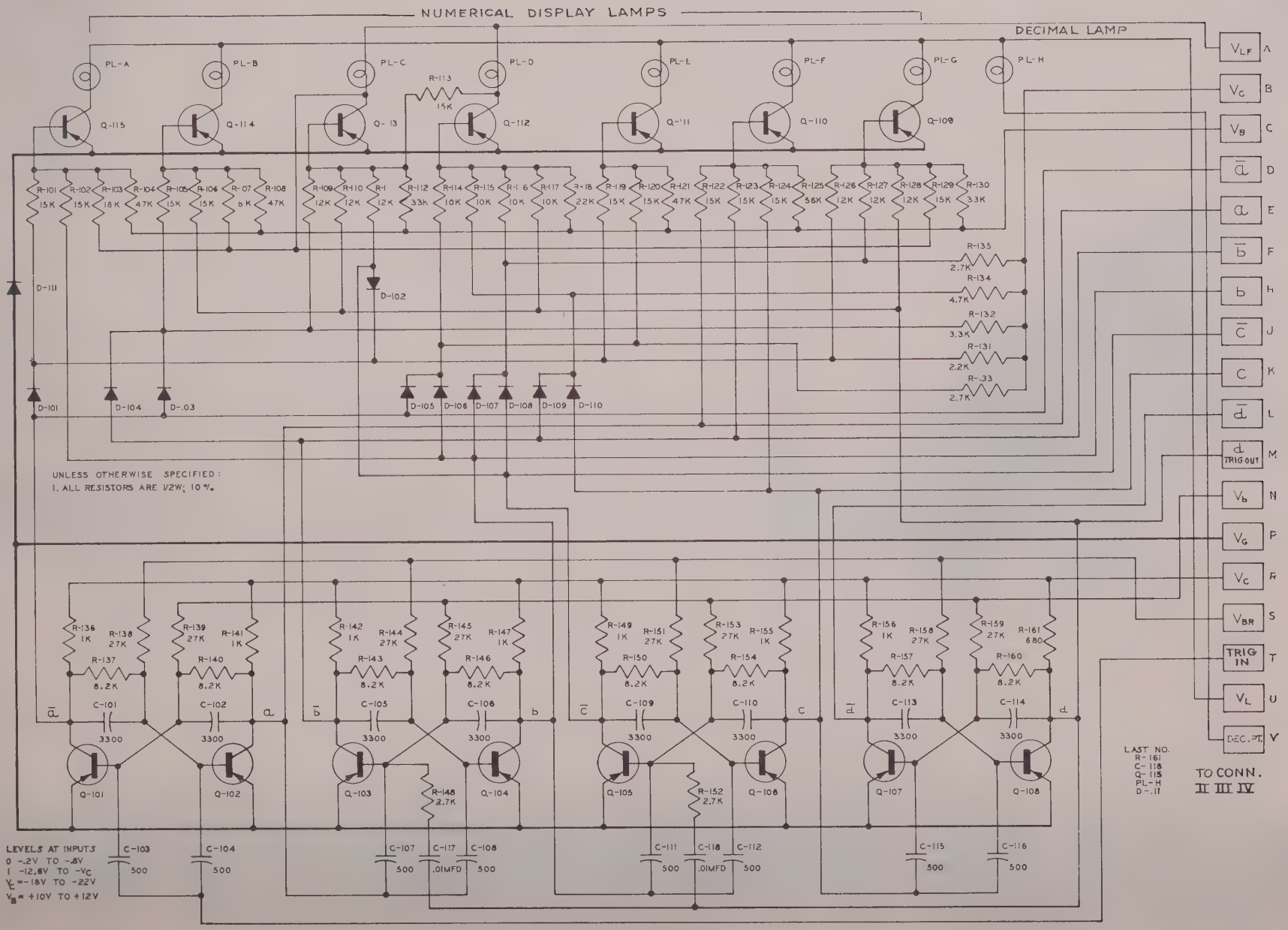
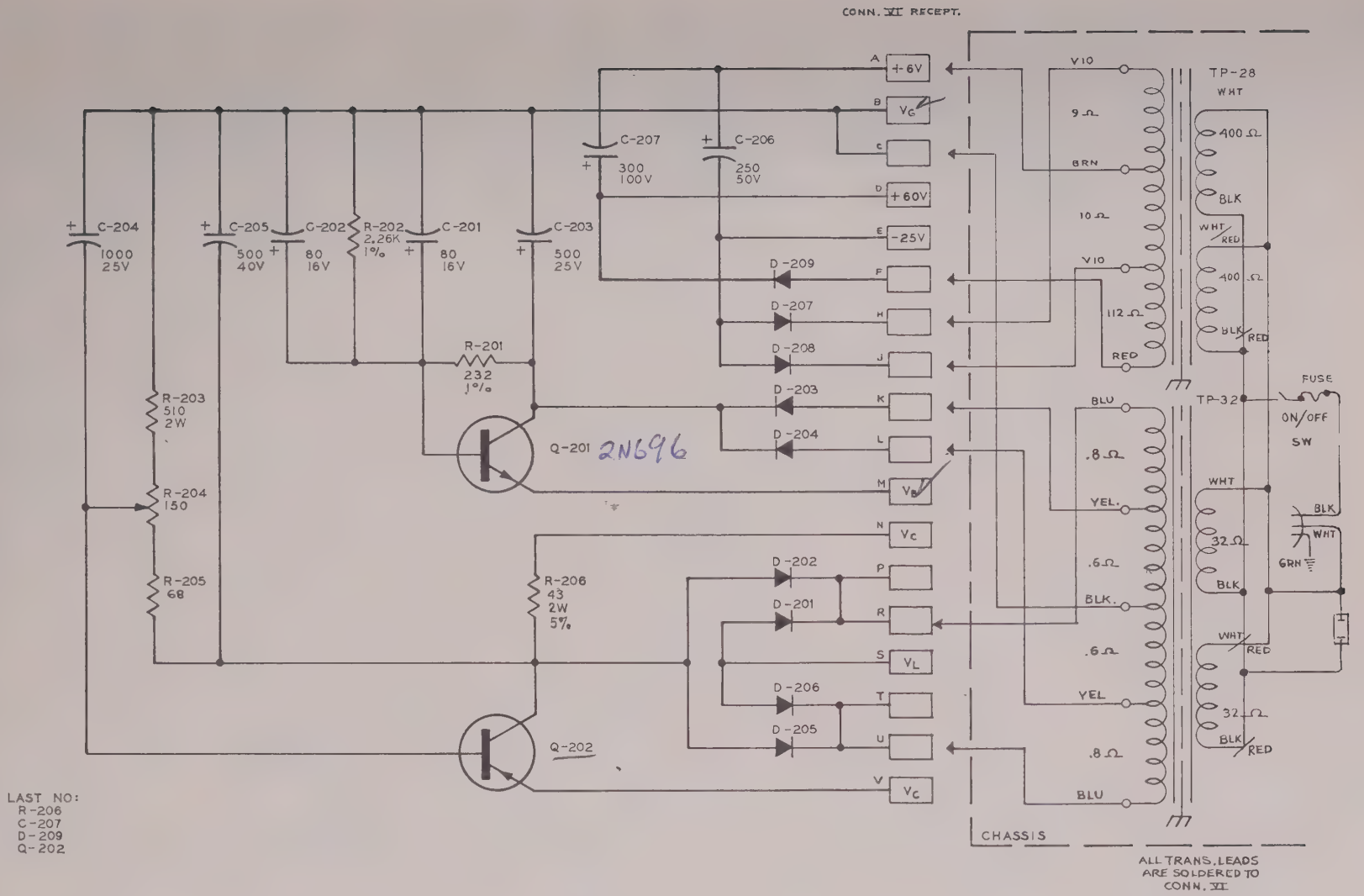


Figure 10. Counter Schematic, BT-57.



LAST NO:
R-206
C-207
D-209
Q-202

Figure 11. Power Supply Schematic, BT-62.

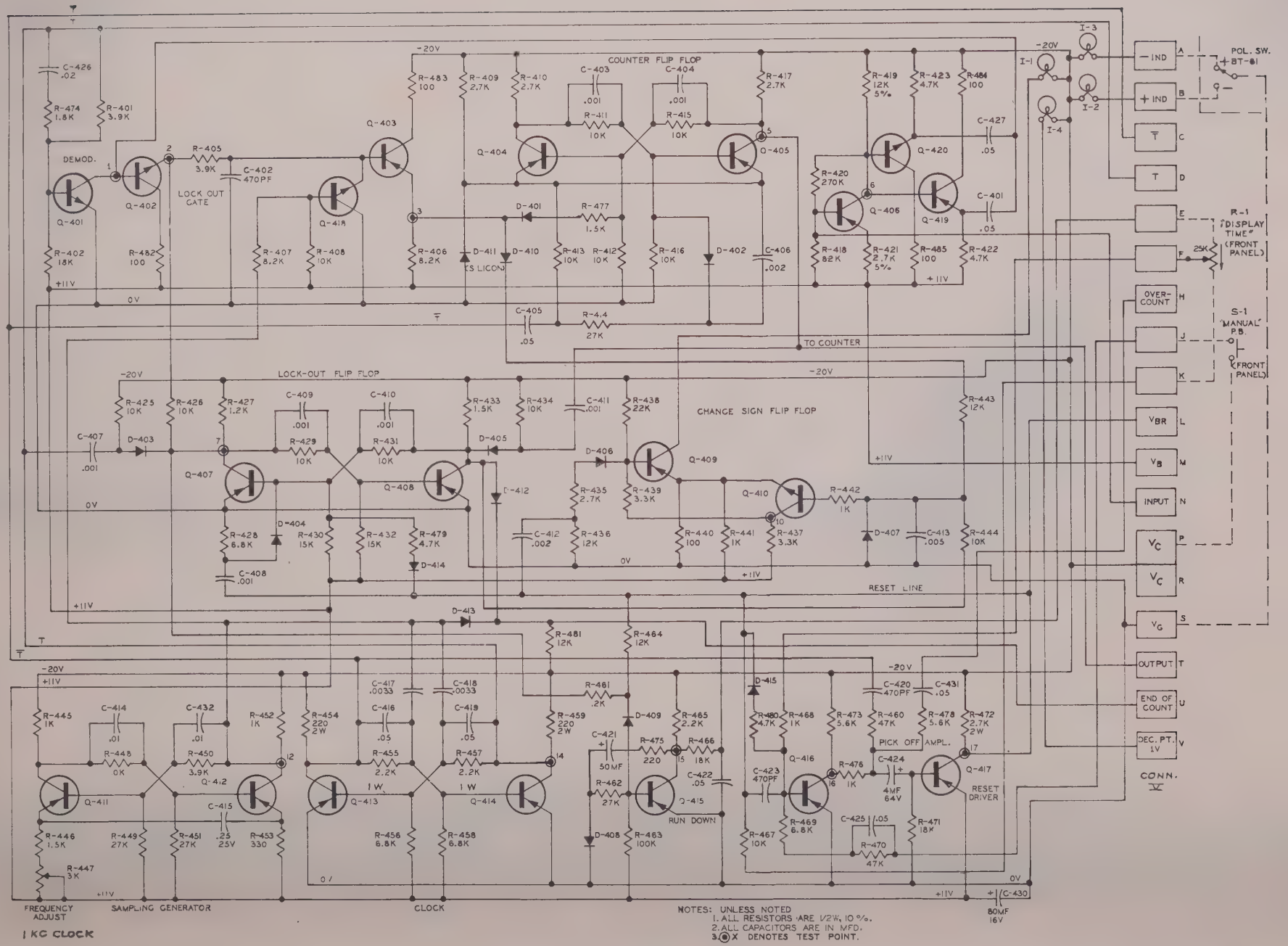
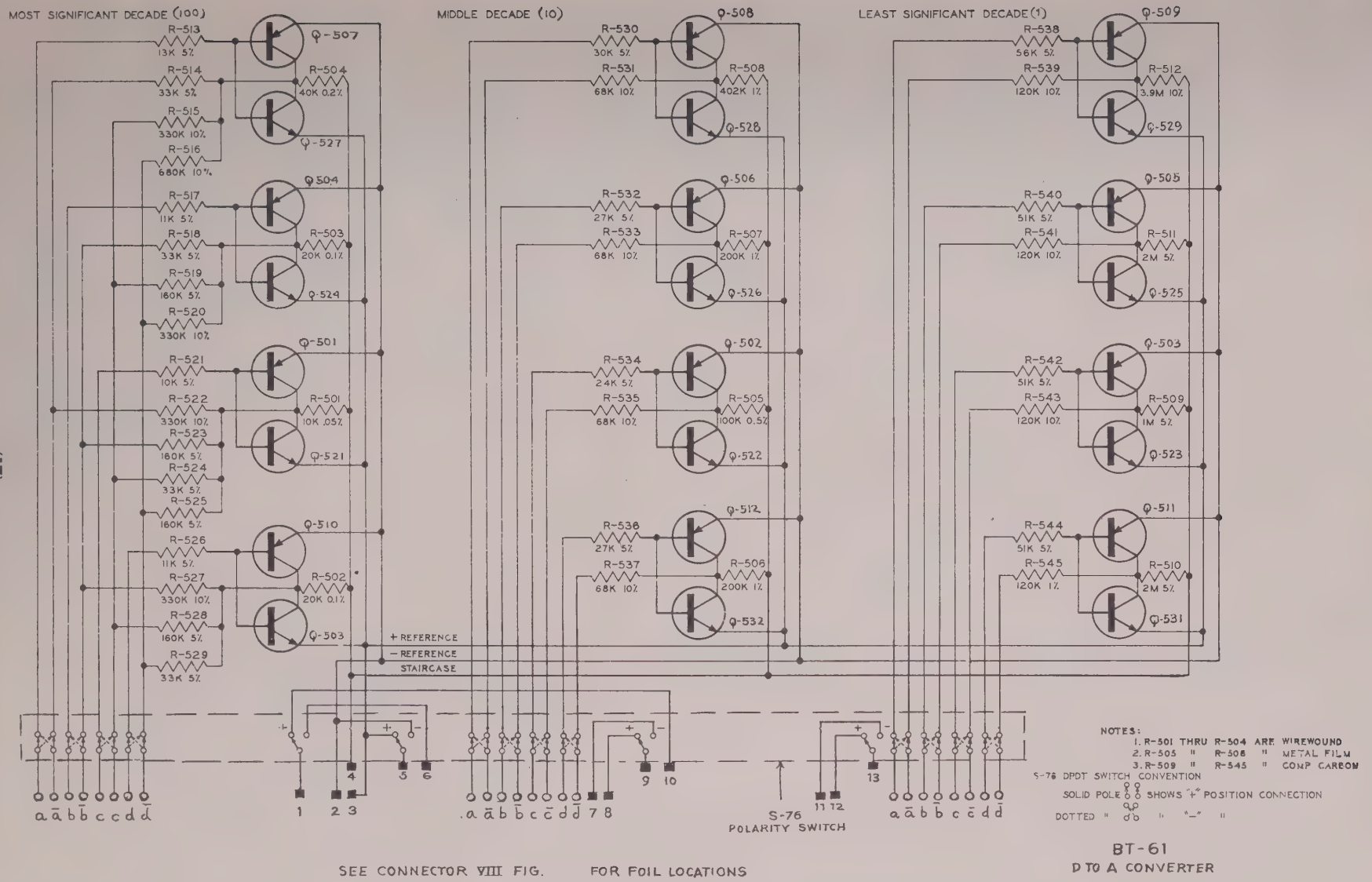


Figure 12. Control Schematic, BT-76.



(17)

Figure 13. D to A Converter Schematic, BT-61.

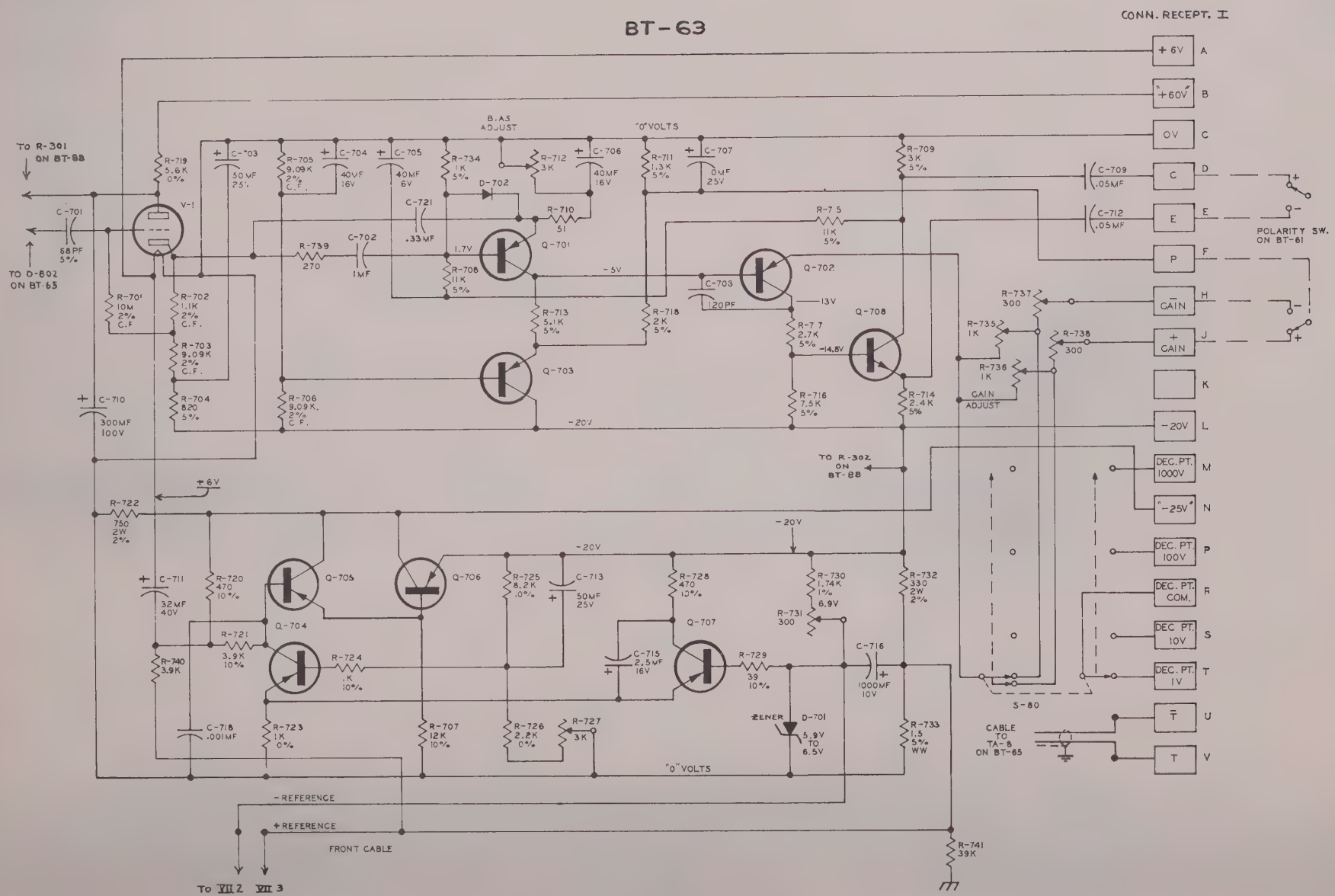


Figure 14. Amplifier Schematic, BT-63.

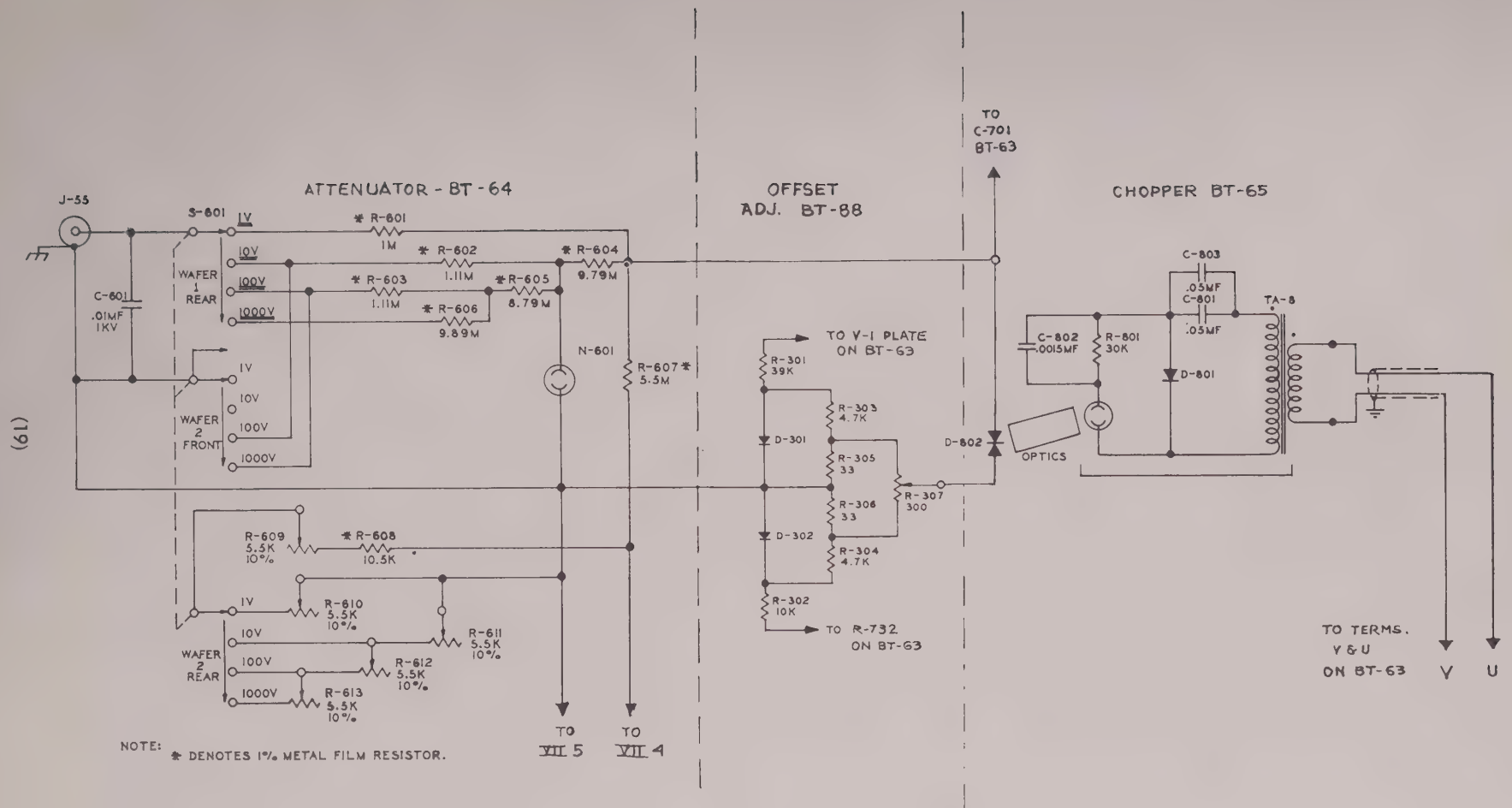


Figure 15. Attenuator, Offset Adjust and Chopper Schematic.

Localizing Chart I:

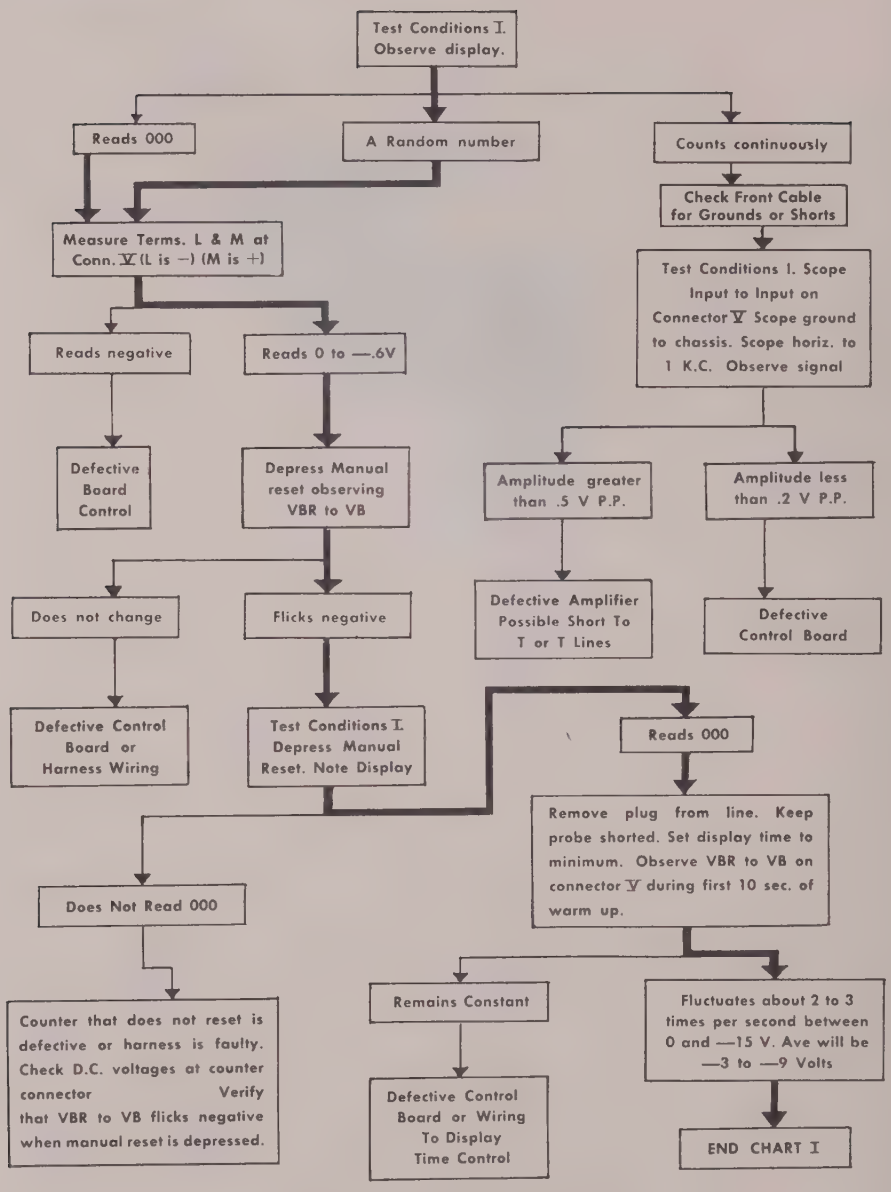

Test Conditions I. Observe display.
Reads 000
A Random number
Counts continuously
Check Front Cable for Grounds or Shorts
Measure Terms. L & M at Conn. V (L is —) (M is +)
Test Conditions I. Scope Input to Input on Connector V Scope ground to chassis. Scope horiz. to 1 K.C. Observe signal
Reads negative
Reads 0 to —.6V
Defective Board Control
Depress Manual reset observing VBR to VB
Amplitude greater than .5 V P.P.
Amplitude less than .2 V P.P.
Defective Amplifier Possible Short To T or T Lines
Defective Control Board
Does not change
Flicks negative
Defective Control Board or Harness Wiring
Test Conditions I. Depress Manual Reset. Note Display
Reads 000
Remove plug from line. Keep probe shorted. Set display time to minimum. Observe VBR to VB on connector V during first 10 sec. of warm up.
Does Not Read 000
Counter that does not reset is defective or harness is faulty. Check D.C. voltages at counter connector Verify that VBR to VB flicks negative when manual reset is depressed.
Remains Constant
Fluctuates about 2 to 3 times per second between 0 and —15 V. Ave will be —3 to —9 Volts
Defective Control Board or Wiring To Display Time Control
END CHART I

Figure 16. Localizing Chart I.

LOCALIZING CHARTS: These two charts contain a list of test conditions and procedures to aid you in pinpointing a case of trouble.

Test Conditions I. Remove the AC plug from the line. Short the probe. Set the DISPLAY TIME to HOLD. Allow the 111 to cool for at least one minute. Apply AC power and make measurements within the first ten seconds. If more than one measurement is to be made, you may find it desirable to remove the nuvistor (V-1) from the amplifier board (BT-63). With V-1 removed there is no time limit on performing the tests.

Localizing Chart II:

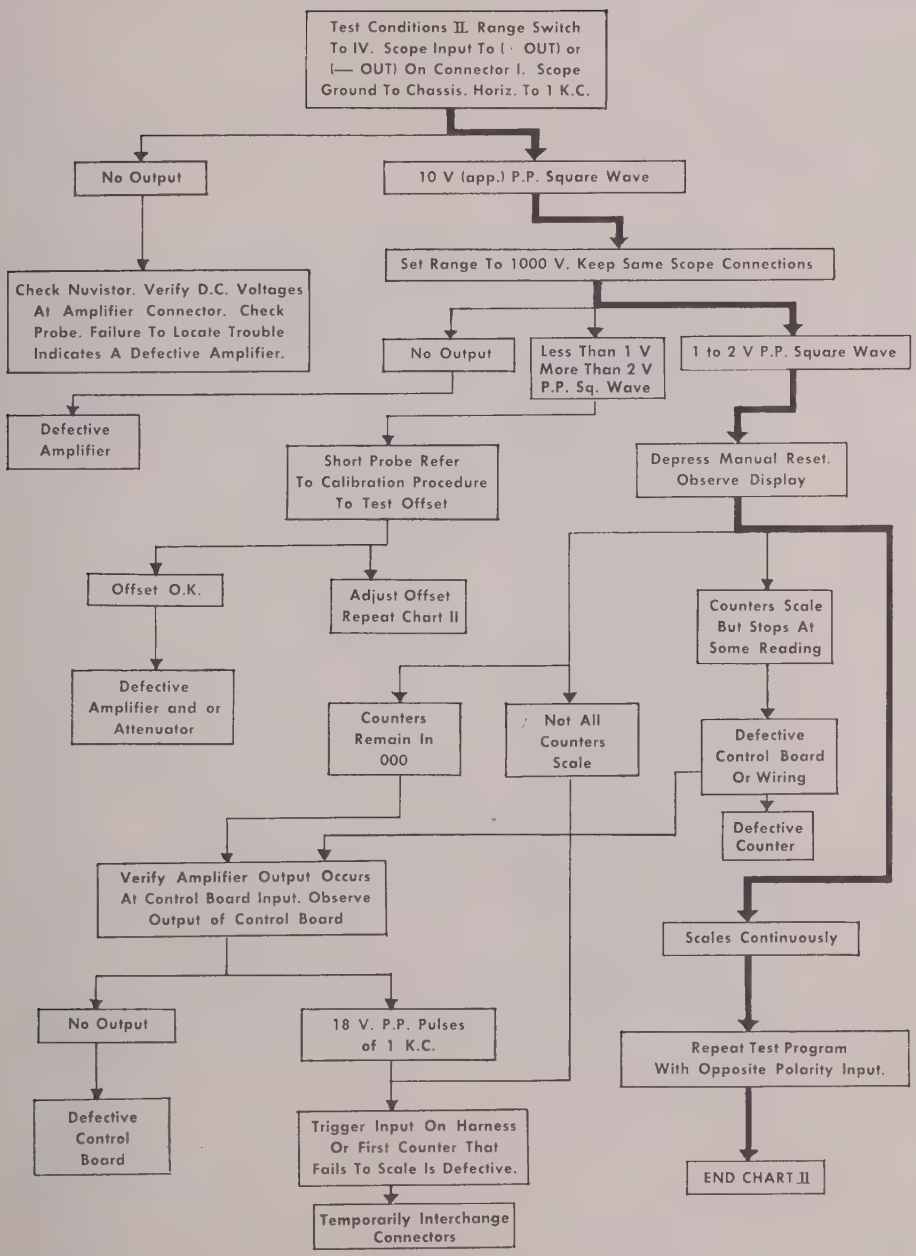

Test Conditions II. Range Switch To IV. Scope Input To (+ OUT) or (— OUT) On Connector I. Scope Ground To Chassis. Horiz. To 1 K.C.
No Output
10 V (app.) P.P. Square Wave
Check Nuvistor. Verify D.C. Voltages At Amplifier Connector. Check Probe. Failure To Locate Trouble Indicates A Defective Amplifier.
Set Range To 1000 V. Keep Same Scope Connections
No Output
Less Than 1 V More Than 2 V P.P. Sq. Wave
1 to 2 V P.P. Square Wave
Defective Amplifier
Short Probe Refer To Calibration Procedure To Test Offset
Depress Manual Reset. Observe Display
Offset O.K.
Adjust Offset Repeat Chart II
Counters Scale But Stops At Some Reading
Defective Amplifier and or Attenuator
Counters Remain In 000
Not All Counters Scale
Defective Control Board Or Wiring
Defective Counter
Verify Amplifier Output Occurs At Control Board Input. Observe Output of Control Board
Scales Continuously
No Output
18 V. P.P. Pulses of 1 K.C.
Repeat Test Program With Opposite Polarity Input.
Defective Control Board
Trigger Input On Harness Or First Counter That Fails To Scale Is Defective.
END CHART II
Temporarily Interchange Connectors

Figure 17. Localizing Chart II.

Test Conditions II. Set DISPLAY TIME to HOLD. Preset to 000 by depressing MANUAL RESET during first 10 second interval. Connect a 3 volt source to input and set POLARITY switch to proper setting. Short D to A output to chassis. See Figure 18. Allow 1 minute warmup. See Figure 9 for location of measuring points.

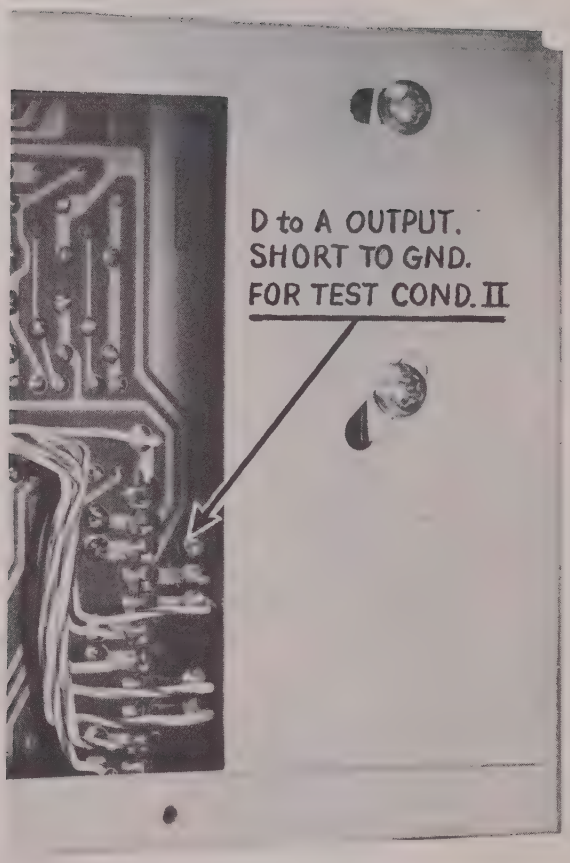


Figure 18. Location of D to A Output

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Simpson Sales
205 Pasadena Avenue
Phone: Area Code 213—254-5136

CALIFORNIA, San Francisco
W. J. Purdy Associates
312 Seventh Street
Phone: Area Code 415—863-3300

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6527 Westbrook Drive
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Earl Associates
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Simpson Electric Company
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N. W. Kathrinus & Co.
2336 South Boeke Street
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Phone: Area Code 913—236-4108

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Phone: Area Code 504—834-8312

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S. K. Macdonald, Inc.
2016 Winford Road
Phone: Area Code 301—435-1760

MASSACHUSETTS, Chestnut Hill
Paul R. Sturgeon & Co., Inc.
1330 Boylston Street
Phone: Area Code 617—734-7710

MICHIGAN, Detroit
R. C. Merchant & Co. Inc.
18411 West McNichols Road
Phone: Area Code 313—535-6000

MINNESOTA, Minneapolis
Mel Foster Co. Inc.
228 South Cedar Lake Road
Phone: Area Code 612—374-2612

MISSOURI, St. Louis
Norman W. Kathrinus & Co. Inc.
2427 Brentwood Boulevard
Phone: Area Code 314—962-5627

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C. T. Carlberg & Associates
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P. O. Box 3177, Sta. D.
Phone: Area Code 505—265-1579

NEW JERSEY, Palisades Park (Branch)
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521 Third Street
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